Ceramic Artificial Ferrite Prepared by Laser Ablation

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Ferrite materials contribute to over a wide range of technologies: MRI (Magnetic Resonance Imaging) in medical applications, magnetic sensors in security applications, wireless communications, computers, radars, corrosion protection, heavy industry, autos, and etc.. Although its use is quite extensive and it is often described in terms of a mature field of study, the understanding of basic interactions at the atomic scale is still at the infancy stage. For the first time we have calculated quantitatively the exchange constants of a well known ferrite material [1]. This theoretical effort will provide the guidance to experimental efforts to generate the next class of ferrite materials with enhanced magnetism. For example, ferrite materials with increased magnetization will allow for the development of sensitive magnetic sensors for medical applications in the detection of tumors or non-invasive detectors and inexpensive equipment, and to other technologies. In Fig. 1 we show the magnetization of manganese ferrite ($MnFe_2O_4$) artificially deposited by laser ablation technique, in which the magnetization on (100) plane of magnesium oxide (MgO) substrate is 15% higher than that on (111) plane. Ferromagnetic resonance (FMR) showed a strong magnetic anisotropy field in the artificial $MnFe_2O_4$ film deposited on (100) plane of MgO, although the current theory predicted that the magnetic anisotropy field in spinel ferrite should be much weaker than demagnetization in general [2].

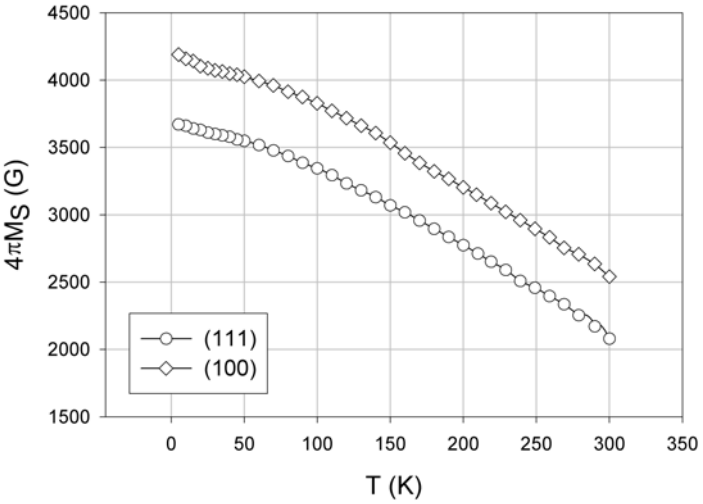

Fig. 1: Magnetization of artificial manganese ferrite ($MnFe_2O_4$) versus temperature.

[1] *Phys. Rev.* **66**, 184420 (2002); [2] submitted to *9th Joint MMM-InterMag Conference*

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Education:

Two undergraduate students (Tim Nadeau and Anurag Bhandari) and one graduate student (Xu Zuo) contributed to this work. Dr. Bernardo Barbiellini of Physics Department was involved with us on the computational aspect of the project. The computer center was a facility funded by the NSF for the purpose of accessing super-computers to the University at large. Undergraduate students Nadeau and Bhandari applied to graduate school and have been accepted. Xu Zuo received his Ph.D. in 2002 and is presently a post-doctoral student and Northeastern University.

Outreach:

We are one of the participating laboratory in which teachers at the high school can work in a laboratory like ours in the summer. The funding is derived from NSF and the program is administrated by Clare Duggan of the CER (Center for electromagnetic research).